

C L A I M S

1. A rechargeable lithium battery including a negative electrode made by depositing a noncrystalline thin film composed
5 entirely or mainly of silicon on a current collector, a positive electrode and a nonaqueous electrolyte, characterized in that said nonaqueous electrolyte contains carbon dioxide dissolved therein.

2. The rechargeable lithium battery as recited in claim
10 1, characterized in that the amount of carbon dioxide dissolved in said nonaqueous electrolyte is at least 0.001 weight %.

3. The rechargeable lithium battery as recited in claim 1, characterized in that the amount of carbon dioxide dissolved in said nonaqueous electrolyte is at least 0.01 weight %.

15 4. The rechargeable lithium battery as recited in claim 1, characterized in that the amount of carbon dioxide dissolved in said nonaqueous electrolyte is at least 0.1 weight %.

5. The rechargeable lithium battery as recited in any one of claims 1 - 4, characterized in that a surface of said current
20 collector has an arithmetic mean roughness Ra of at least 0.1 μm .

6. The rechargeable lithium battery as recited in any one of claims 1 - 5, characterized in that said current collector comprises a heat-resisting copper alloy foil.

25 7. The rechargeable lithium battery as recited in claim

6, characterized in that said current collector comprises a heat-resisting copper alloy foil having an electrolytic copper or copper alloy surface layer.

8. The rechargeable lithium battery as recited in any one
5 of claims 1 - 7, characterized in that said noncrystalline thin film composed mainly of silicon contains at least one of cobalt and iron.

9. The rechargeable lithium battery as recited in any one
of claims 1 - 8, characterized in that said nonaqueous electrolyte
10 contains a fluorine-containing compound or LiClO_4 .

10. The rechargeable lithium battery as recited in claim
9, characterized in that said fluorine-containing compound is LiXF_y (wherein X is P, As, Sb, B, Bi, Al, Ga or In; y is 6 if
X is P, As or Sb and y is 4 if X is B, Bi, Al, Ga or In);
15 $\text{LiN}(\text{C}_m\text{F}_{2m+1}\text{SO}_2)(\text{C}_n\text{F}_{2n+1}\text{SO}_2)$ (wherein m and n are independently
integers of 1 - 4); or a fluorine-containing lithium borate
derivative.

11. The rechargeable lithium battery as recited in claim
10, characterized in that said fluorine-containing lithium
20 borate derivative is $\text{LiBF}_2(\text{O}_x)$.

12. The rechargeable lithium battery as recited in any
one of claims 1 - 11, characterized in that said nonaqueous
electrolyte contains cyclic carbonate and chain carbonate.

13. The rechargeable lithium battery as recited in any
25 one of claims 1 - 11, characterized in that said nonaqueous

electrolyte contains a mixed solvent of cyclic carbonate and chain carbonate.

14. The rechargeable lithium battery as recited in claim 12 or 13, characterized in that at least one of ethylene carbonate
5 and propylene carbonate is contained as said cyclic carbonate.

15. The rechargeable lithium battery as recited in any one of claims 12 - 14, characterized in that diethyl carbonate is contained as said chain carbonate.

16. The rechargeable lithium battery as recited in any
10 one of claims 12 - 15, characterized in that cyclic carbonate having an unsaturated carbon bond and the other cyclic carbonate are contained as said cyclic carbonate.

17. The rechargeable lithium battery as recited in claim 16, characterized in that said cyclic carbonate having an
15 unsaturated carbon bond is vinylene carbonate.

18. The rechargeable lithium battery as recited in any one of claims 12 - 17, characterized in that a content by volume of said cyclic carbonate (excluding the cyclic carbonate having an unsaturated carbon bond) does not exceed 70 %, based on the
20 total volume of the cyclic carbonate (excluding the cyclic carbonate having an unsaturated carbon bond) and the chain carbonate.

19. The rechargeable lithium battery as recited in any one of claims 12 - 17, characterized in that a content by volume
25 of said cyclic carbonate (excluding the cyclic carbonate having

an unsaturated carbon bond) is 0.1 - 20 %, based on the total volume of the cyclic carbonate (excluding the cyclic carbonate having an unsaturated carbon bond) and the chain carbonate.

20. The rechargeable lithium battery as recited in any one of claims 12 - 17, characterized in that a content by volume of said cyclic carbonate (excluding the cyclic carbonate having an unsaturated carbon bond) is 50 - 70 %, based on the total volume of the cyclic carbonate (excluding the cyclic carbonate having an unsaturated carbon bond) and the chain carbonate.

21. The rechargeable lithium battery as recited in any one of claims 16 - 20, characterized in that a content by weight of said cyclic carbonate having an unsaturated carbon bond is 0.1 - 10 %, based on the total weight of the cyclic carbonate (excluding the cyclic carbonate having an unsaturated carbon bond) and the chain carbonate.

22. The rechargeable lithium battery as recited in any one of claims 1 - 21, characterized in that said noncrystalline thin film is formed by an evaporation process.

23. A method for fabricating a rechargeable lithium battery including a negative electrode, a positive electrode and a nonaqueous electrolyte, characterized as comprising the steps of:

depositing a noncrystalline thin film composed entirely or mainly of silicon on a current collector to prepare said negative electrode;

dissolving carbon dioxide in said nonaqueous electrolyte;
and

assembling a rechargeable lithium battery using said
negative electrode, positive electrode and nonaqueous
5 electrolyte.

24. The method for fabricating a rechargeable lithium
battery as recited in claim 23, characterized in that the step
of dissolving carbon dioxide in the nonaqueous electrolyte
includes a step of blowing gaseous carbon dioxide into the
10 nonaqueous electrolyte.

25. The method for fabricating a rechargeable lithium
battery as recited in claim 23 or 24, characterized in that the
step of assembling a rechargeable lithium battery includes a
step of assembling a rechargeable lithium battery under the
15 atmosphere including carbon dioxide.

26. The method for fabricating a rechargeable lithium
battery as recited in any one of claims 23 - 25, characterized
in that said noncrystalline thin film is deposited by supplying
a raw material from a vapor phase.

20 27. The method for fabricating a rechargeable lithium
battery as recited in claim 26, characterized in that said
noncrystalline thin film is deposited by a sputtering, chemical
vapor deposition or evaporation process.

28. The method for fabricating a rechargeable lithium
25 battery as recited in claim 26, characterized in that said

noncrystalline thin film is deposited by an evaporation process.